Selectable Image Capture and Transformation in a Digital Camera

Technical Field

The present invention relates to selectable image capture and transformation in a digital camera and more particularly, though not exclusively, relates to a method of capturing an image in a digital camera by reconstruction of one or more of: area separation in the image, object separation in the image, and by real-time object detection with auto-shutter-release.

Background

In the era of digital technology, the taking of photographs is an easy task. The user takes a photograph by using the digital camera to capture an image, and previews the result. If the result is desired the user can save it; but if it is not suitable the user can delete it and take another picture. This is good for still objects but for a moving object it is not as easy and the desired result may be hard to achieve.

Many camera manufacturers have enhanced the technology in their cameras to enable the capturing of images of a moving object. Further improvements in digital and photography technologies have enabled a sequence of the capturing and saving of multiple images for consideration and selection at a later time. From the images captured there may be a certain object (e.g. emotion/action/vista) in one image that is desirable in another image of the sequence. At present there is no digital camera that allows the selection and transfer of one or more areas and/or objects from one or more images and the forming of a desired image from those areas and/or objects.

Digital photography technologies have also enhanced camera systems such that a camera is able to detect and track an object or objects desired by the user. Although this tracking capability may be useful, it may not be able to capture the desired emotion or action for the photograph the user desires. For example, all persons in the photograph are smiling.

Summary

According to an exemplary aspect there is provided a method for selectable image capture and transformation in a digital camera. The method comprises capturing a plurality of images and dividing each of the plurality of images into a plurality of portions. Image data in each of the plurality of portions is then compared for each of the plurality of images. Image data for a selected one of each of the plurality of portions is then saved. All possible combinations of the plurality of portions of the plurality of images are compiled. At least one optimal combination is then determined.

Any differences of others of each of the plurality of portions of the plurality of images may be saved with the image data of the selected one of each of the plurality of portions. The plurality of portions may be the same for each of the plurality of images. The image data may be compared by comparing pixels vertically and horizontally in each portion.

According to another exemplary aspect there is provided a method for selectable image capture and transformation in a digital camera. The method comprises capturing a plurality of images and detecting at least one desired object in each of the plurality of images. Image data for each object of the at least one object for each of the plurality of images is then compared. Image data for a selected one of each of the at least one object is then saved. All possible combinations of the at least one object of the plurality of

images are compiled. At least one optimal combination is determined.

Any differences of others of each of the at least one object of the plurality of images may be saved with the image data of the selected one of the at least one object. The at least one object may be the same for each of the plurality of images. The image data may be compared by comparing pixels vertically and horizontally for the at least one object. Any object not of interest may be ignored.

For both aspects, the at least one optimal combination may be determined by considering all the possible combinations according to at least one criterion to provide at least one pre-selected combination for consideration. Each of the possible combinations may be a new image constructed using objects and/or areas from various images to form the constructed image. Alternatively or additionally, each of the possible combinations may be an existing image having one or more objects and/or areas replaced by corresponding objects and/or areas from other images.

According to a further exemplary aspect there is provided a method for selectable image capture and transformation in a digital camera. The method comprises determining at least one criterion for the image to be captured and activating a shutter release. At least one object is detected and tracked using a signal from at least one image sensor. A determination is made whether the at least one criterion is met. When the at least one criterion is met, the image is captured. When the image is captured, the shutter may be released, and the image may be stored. The detection and tracking may be by use of an image capturing processor using the signals from the at least one image sensor. This exemplary aspect may be used in conjunction with either or both of the exemplary

aspects described above. The method of all exemplary aspects may be performed in a processor of a digital camera.

The processor may comprise a software arrangement that is operable on the processor and that comprises a computer program that configures the processor to perform the method as described above.

According to a final exemplary aspect there is provided a digital camera comprising a processor, the processor comprising a software arrangement that is operable on the processor and that comprises a computer program that configures the processor to perform the above method.

Brief Description of the Drawings

In order that the invention may be fully understood and readily put into practical effect there shall now be described by way of non-limitative example only exemplary embodiments of the present invention, the description being with reference to the accompanying illustrative drawings.

In the drawings:

Figure 1 is an illustration of an exemplary embodiment of a digital camera;

Figure 2 is a block diagram of the digital camera of Figure 1;

Figure 3 is an illustration of the separation of captured images into N portions;

Figure 4 is an illustration of reconstructed images with fixed areas of separation;

Figure 5 is an illustration of object detection based on area separation;

Figure 6 is an illustration of optical selection based on area separation; and

Figure 7 is a flow chart for real-time object detection followed by auto-shutter-release.

Detailed Description of the Exemplary Embodiments

The exemplary embodiment is of image reconstruction that allows the selection and transfer of at least one area and/or object from one or more images to form a desired constructed image or images. The constructed image may be a new image constructed using objects and/or areas from various images to form the constructed image. Alternatively, the constructed image may be an existing image having one or more objects and/or areas replaced by corresponding objects and/or areas from other images. The real-time object detection method tracks the object(s) and captures the image when desired criteria are satisfied. The exemplary methods may be performed in the digital camera, rather than in an external processor such as, for example, a computer.

As shown in Figures 1 and 2, there is a digital camera 10 having a body 12, a lens 14, and a shutter release 16. The digital camera 10 has an image capturing processor 18, main processor 20, memory 22 and display 24.

In Figure 3, in a first exemplary embodiment a sequence of images such as, for example, a sequence of Y images is first taken of the object(s) or vista using the digital camera 10. After the digital camera 10 has captured the images of the object(s) or vista, the first image captured and all subsequence images captured to the Yth image are each divided into N portions – 9 as shown in Figure 3. The number of portions may be as required or desired and may be pre-set, may be user set, or may be automatically determined based on the density of the data in the image.

Comparison for each of the N areas of all Y images is conducted for each of the Y images. However, the number of portions, their size, shape, layout and configuration, will be constant for each of the Y images. Comparison is by comparing each image

pixel in each portion in the vertical and horizontal directions. If portion A when compared in all Y pictures is has no change, then one portion A is saved and kept as only one area A is required to be kept, it being constant for all Y images. The portion A that is saved and kept will be that of the first image taken. The next portion B is then compared for each of the Y images. If portion B has changes among the Y images, one portion B is saved and kept, and every change in portion B is recorded. The set for portion B consists of one image for B and all changes in portion B for each of the Y images. The same process is conducted for all the N portions of the Y images. Upon completion of comparison of all the N portions of the Y images, the desired image can be reconstructed by taking one element A, B, ...N in the set of each portion and joining them sequentially in the order A, B, C....N to form a constructed image of N component areas. Optional portions of each of the N portions may be selected for use in the construction of the desired image. Depending on the user's interest, several constructed images may be selected and saved. For example, in a group portrait, one saved constructed image may have all persons looking at the camera and smiling, and another may have all persons looking away from the camera and frowning.

In determining which portion of B to save, and the changes in B to save, a first check is made to be certain that the image passes a basic threshold test of acceptability is conducted to ensure the image satisfies certain basic and predetermined criteria. The criteria may include, for example, that: the image is in focus, sufficient light was available for the image to be correctly taken, a flash was required for the image to be captured and the flash had operated correctly and sufficiently, the light when taking the image was not excessive, the object of the image was not moving such that the image was blurred, and the camera was not moving or shaking when the image was captured.

Furthermore, the memory capacity of the camera will impact on this. If many images are taken, the memory capacity of the camera may be exceeded. In this case there would be an error message displayed.

The following correlation S may be used for comparison with a threshold for determining if the portion A, B, ...N of the image changes from 1 through to Y.

$$S = \frac{1}{NM} \sum_{i=1}^{N} \sum_{j=1}^{M} P_{ij}^{x} P_{ij}^{y} \qquad (1)$$

where N is the number of image pixels in vertical direction in a portion, M is the number of image pixels in horizontal direction in a portion. P_{ij}^{x} indicates the pixel of row i and column j in element x in a change set. If S is smaller than a set threshold, the portion is regarded as changed.

There are two approaches for the division of the picture into N portions: fixed area separation and separation based on special object detection.

As shown in Figure 3, each captured image is uniformly divided in the vertical and horizontal directions. In Figure 3, portion A is not changed in each of the Y pictures. However, portions B, C and D vary. The constructed options are illustrated in Figure 4.

The system can list all the options of the constructed images for the user to decide which is desired and to be saved. However, due to the number of combinations and permutations that are possible, the number of possible options generated may be so large as to be impractical. It may not be convenient for the user to check them individually, one at a time, on the display 24 or on a computer (not shown).

One preferred option is to make criteria for the selection and let the digital camera processor 20 pre-select optimal options from all possible options. The user can then decide those image or images that are desired from the pre-selected options. The criteria may be pre-set or user selected from a menu. One such criterion may be that of the subject (human) face is looking towards the camera 10. This can be by using known face detection or face-priority technologies such as, for example, that which has been successfully used in known digital cameras such as, for example the "Sony" "Cyber-shot" digital camera DSC-H9/B. Other cameras that use face recognition or face priority technologies are the "Canon" Digital IXUS 850IS; "Nikon" "Coolpix" 7900, 5900 and 7600; and "Fujifilm" "Finepix" F31fd. The "ArcSoft" Face tracking is also a similar technology. More preferably, it may be by using emotion detection based on the face detection proposal of Ming-Hsuan Yang, David J. Friegman and Narendra Ahuja in their paper "Detecting Faces in Images: A Survey" as published in IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 24, No. 1, January 2002. The criteria can be set, for example, so that all the faces in the picture are smiling. The camera processor 20 will therefore conduct a first stage of detection of optimal constructions using face recognition, and then conduct a second stage of detection of optimal constructions using emotion detection. The final result should be a small number of constructed images that satisfy the face recognition and emotion detection criteria. For a large number of faces (e.g. a large group photograph) there may be a maximum number of faces recognized, and if their features are satisfied, the image is taken. The maximum number may be preset, or may be user set. It may depend on the processing power and memory of the camera. Furthermore, there may be a predetermined time limit so that if all are not satisfied within a predetermined time, an operator of the camera can decide whether or not to proceed with the image capture.

Fixed area separation is relatively simple. However, it may separate the picture into portions until each portion is too small for processing. Moreover, a change from one image to another may include irrelevant or unimportant changes. For example, a recorded change in a portion of all Y images may be due solely to the leaves of a tree moving in the background due to the effects of wind as the sequence of Y images is taken. The inconsequential change in the record will create too many options for selection. A more intelligent method is to detect the object of interest, for example, the human face. The image areas will be separated according to the detected objects. Only when the desired objects change is the change recorded.

Figures 5 and 6 show object-detection based separation. In the exemplary embodiment shown there are three faces detected in the images. Face A does not change for each of the Y images. Faces B and C vary to some extent in the Y images. Although background detail D also changes, it is not of concern as is inherent in face recognition and face priority technologies. Therefore, the construction will be performed only for the objects B and C as they vary through the Y images. This is shown in Figure 6. Accordingly, the number of options is reduced (Figure 6) as the only variations are in objects B and C. As such it is now easier for option selection, and the processing complexity is reduced. Processing of the objects B and C is as described above

In the exemplary methods described above, all processes are activated after capturing Y images – the processing takes place after all the images are captured. All the images captured must be registered in the digital camera processor 20. If the image resolution is high, registering and/or compressing the images is time consuming, and large amount of memory 22 will be used. In a further exemplary embodiment as illustrated in Figure 7,

object detection may be used at the time of capturing a sequence of images. The processor 20 will track object(s) in real-time through by tracking the signal from the image capturing processor 18. The image capturing processor 18 may be a CCD or CMOS sensor. If the required criteria are satisfied, the desired image is captured. This may be a single capture.

The process flow is:

(a) a "shutter release assist" option is selected and activated (701). The criteria are then set from a menu on the camera display 24. The criteria may be, for example, face to camera and smiling;

(b) when the shutter release 16 is pressed (702) object detection and tracking takes place in processor 20 (703) using the signal from the CCD processor 18. The user does not need to continue to press on the shutter release 16 as the camera does not release the shutter immediately, but the face detection algorithm starts and locates and tracks all faces in the image area;

(c) the image is considered by the processor 20 to determine if the desired criteria are met (704); and

(d) when the desired criteria are met (705) the image is captured, the shutter 16 released, and the image is stored (706).

This process may be used in place of or in addition to the process described with reference to Figures 3 to 6.

Naturally, face recognition and face priority are not the only relevant technologies used. Feature recognition and feature priority settings may also be used, amongst others. The

feature may be any discernable feature in the captured image: a building, tree, vessel, vehicle, person, athlete, sportsperson, and so forth.

The processor 20 of all exemplary aspects and embodiments may contain a software arrangement that is operable on the processor 20 and that comprises a computer program that configures the processor to perform the method and/or functions described above.

Whilst there has been described in the foregoing description exemplary embodiments of the present invention, it will be understood by those skilled in the technology concerned that many variations in details of design, construction and/or operation may be made without departing from the present invention.

The Claims:

1. A method for selectable image capture and transformation in a digital camera, the method comprising:

capturing a plurality of images;

forming sets of image portions by dividing each of the plurality of images into a plurality of portions, each set of image portions comprising corresponding portions of the plurality of images;

comparing image data within each set of image portions;;

selecting a portion from each set of image portions;

saving image data for the selected portion from each set of image portions;

compiling all possible combinations of the image portions; and

determining at least one optimal combination.

2. A method as claimed in claim 1, wherein any differences between the selected portion and the remaining portions from each set of image portions are saved with the image data of the selected portion from the set of image portions.

3. A method as claimed in claim 1 or claim 2, wherein the plurality of portions are the same for each of the plurality of images.

4. A method as claimed in any one of claims 1 to 3, wherein the image data is compared by comparing pixels vertically and horizontally in each portion.

5. A method for selectable image capture and transformation in a digital camera, the method comprising:

capturing a plurality of images;

forming sets of objects by detecting at least one desired object in each of the plurality of images, each set of objects comprising corresponding detected objects of the plurality of images;

comparing image data within each set of objects;

selecting an object from each set of objects;

saving image data for the selected object from each set of objects;
compiling all possible combinations of the detected objects; and
determining at least one optimal combination.

6. A method as claimed in claim 5, wherein any differences between the selected object and the remaining objects from each set of objects are saved with the image data of the selected object from the set of objects.

7. A method as claimed in claim 5 or claim 6, wherein the at least one object is the same for each of the plurality of images.

8. A method as claimed in any one of claims 5 to 7, wherein the image data is compared by comparing pixels vertically and horizontally for the at least one object.

9. A method as claimed in any one of claims 5 to 8, wherein any object not of interest is ignored.

10. A method as claimed in any one of claims 1 to 9, wherein the at least one optimal combination is determined by considering all the possible combinations according to at least one criterion to provide at least one pre-selected combination for consideration.

11. A method as claimed in any one of claims 1 to 10, wherein each of the possible combinations is a new image constructed using objects and/or areas from various images to form the constructed image.

12. A method as claimed in any one of claims 1 to 10, wherein each of the possible combinations is an existing image having one or more objects and/or areas replaced by corresponding objects and/or areas from other images.

13. A method as claimed in any one of claims 1 to 12, wherein the method is performed in a processor of the digital camera.

14. A method as claimed in claim 13, wherein the processor comprises a software arrangement that is operable on the processor and that comprises a computer program that configures the processor to perform the method as claimed in any one of claims 1 to 12.

15. A digital camera comprising a processor, the processor comprising a software arrangement that is operable on the processor and that comprises a computer program that configures the processor to perform the method as claimed in any one of claims 1 to 12.